Quarterly Research Report

· Disturbance and management of Southern Ecosystems · SRS4104

The Project Leader's Column

Welcome, new readers, to our latest Quarterly Research Report. We are a little behind schedule in getting this to you but I trust the information remains useful. Our staff is growing and new research projects begin almost daily. In future reports you will hear from the additions to the Smoke Management Team, Scott Goodrick and Yongqiang Liu. Mac Callaham has changed status and moved from post-doc at Clemson to disturbance ecologist at Athens. We have added two new scientists to our fire research teams. Joe O'Brien brings ecophysiology and Ralph DiCosty adds soil chemistry expertise; both will be located in Athens.

New research is beginning with university cooperators. Michael Wimberly, a landscape ecologist at the University of Georgia, and I have begun a study "Landscape-scale characterization of the wildland-urban interface in the Southeastern U.S.-Development and testing of new methodologies." This work will help us develop fuel management strategies for urbanizing areas by enhancing our ability to recognize and characterize the extent and spatial distribution of the interface across large landscapes. This work is funded under the National Fire Plan.

Deborah Kennard, also with National Fire Plan funding, has begun work on a hypertext encyclopedia of fire information in the South. The overall objective of this work is to synthesize and integrate the results from the last 50 years of fire science research and translate it into an Internet-based encyclopedia. The encyclopedia will accommoate users of varying skill and interest levels, helping the user with problem solving using hypertext technology applied to a knowledge base of fire behavior and fire effects. Cooperators for this work include faculty at Auburn, Georgia, Florida, and Clemson Universities.

Research Highlights

SRS 4104.
320 Green Street
Athens, Ga 30602
www.srs.fs.fed.us/disturbance

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Ecosystem Productivity and Function

Regeneration of Southern Appalachian Ridgetop Pine Communities with Prescribed Crown Fires

HISTORY/BACKGROUND:

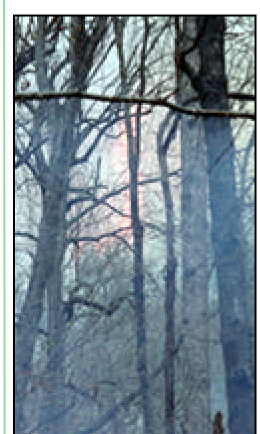
After several decades of fire suppression, ridgetop pine communities of the Southern Appalachians are entering later seral stages and beginning to disappear. They typically have Table Mountain pines (*Pinus pungens*) and pitch pines (*P. rigida*) in the overstory, which are being replaced by shade-tolerant oaks. Previous research suggests that high-intensity stand-replacement fires are needed to restore these communities because they will open the forest canopy and expose mineral soil. However, this work was based on observations made after wildfires, and prescribed stand-replacement fires have not been tested. A series of papers was published in the proceedings of the Eleventh Biennial Southern Silvicultural Research Conference describing results of ongoing RWU research on various components of ridgetop pine communities.

Ridgetop pine communities are declining due to succession and fire exclusion.

RESEARCH RESULTS:

In a comparison of regeneration success after fires of varying intensity, high and medium-high intensity fires killed most overstory trees and provided adequate sunlight for pine seedlings. Medium-low and low intensity fires did not kill overstory trees and left too much shade on the forest floor. Post-burn duff was deep and did not vary by fire intensity. We observed sufficient seedling densities to restore pine-dominated stands (< 9,000 per ha) after all but the highest intensity fires. Many seedlings survived the first growing season as their roots penetrated duff up to 7.5 cm deep to reach mineral soil. Hardwood rootstocks sprouted on sites treated with all fire intensities and may out-compete pine seedlings.

Poor regeneration after high-intensity fires was unexpected because these fires were suggested by previous research. However, a study of seedbed habitat, conducted in a greenhouse and in the field, showed that pine seedlings had better survival in the presence of low shade and thin duff than in full sunlight and with no duff. These results suggest that high intensity fires reduce seedbed habitat quality by drying the site. Another study showed that high-intensity fires reduced mycorrhizal abundance and, therefore, limited moisture availability for germinants. A study of seed biology showed that poor regeneration after high-intensity fires was not likely caused by a poor seed source. Rather, the fires may have consumed cones or killed seed.



High-intensity fires were thought to be necessary to open the overstory and reduce duff for successful pine regeneration.

Four studies provide evidence that ridgetop pine communities were historically created and maintained by multiple low-intensity fires rather than a single stand-replacement fire. A dendrochronology study shows that these stands are unevenly aged with trees ranging from 50 to 150 years old. Pines regenerated frequently from approximately 1850 to 1950, probably due to open conditions maintained by low-intensity fires. Mountain laurel (*Kalmia latifolia*) became more common after 1950, probably due to fire exclusion. The seed biology study indicates that viable seeds occur on trees as young as 5 years, suggesting an adaptation to frequent burning. A study of multiple low-intensity fires shows that ridgetop sites have open understories and begin to support pine regeneration after three low-intensity proscribed fires. Even though fire was less frequent in cove sites, rhododendron (*Rhododendron maximum*) is becoming ecologically dominant preventing regeneration of shade tolerant and intolerant species.

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PRACTICAL APPLICATIONS:

Either single fires of relatively high intensity or multiple low-intensity fires can achieve successful regeneration of ridgetop pine communities. This work indicates that crown fires are too hot and potentially damage the site. Medium-high intensity fires, which reach into the lower crowns of pines, are safer and provide abundant regeneration. Multiple low-intensity fires require a greater investment of time but better mimic historic burning regimes. This knowledge will allow a wider burning window and increase worker safety because severe weather conditions are not required for low-intensity fires. Public land managers throughout the southern Appalachians use these results.

Multiple low-intensity fires may be better choice because they are safer and can be conducted during a wider burning window.

BENEFITS:

Because prescription guidelines developed by this work are more conservative and safer, there will be a greater opportunity for prescribed burning to be accepted by the community and by land managers. Regeneration of these stands by means other than prescribed burning is unlikely because most stands are in remote locations and inaccessible to equipment. Single fires of moderate intensity or multiple fires of low intensity can successfully reverse the successional pattern that would eventually eliminate this community type from the Southern Appalachians.

PROGRESS:

Three experimental fires were completed in previous years. Study plots in all burn units were remeasured during Spring 2002 to help follow early stand dynamics as affected by fires of varying intensity.

COOPERATORS:

Great Smoky Mountains National Park, Chatahoochie National Forest, Sumter National Forest, South Carolina Department of Natural Resources, The University of Tennessee-Knoxville, and Clemson University.

CONTACT PERSON: Thomas A. Waldrop (twaldrop@fs.fed.us)

Seedbed habitat is enhanced by multiple low-intensity fires that reduce mountain laurel cover but leave some shade and duff intact.

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Ecosystem Productivity and Function

Use of Earthworm Additions to Accelerate Recovery of Petroleum Contaminated Soils

BACKGROUND:

There are more than 15,000 sites in the US with soils contaminated by petroleum compounds. Many of these sites are "land farms" where petroleum waste from exploration and pumping (E&P) operations is purposely applied to the soil surface for bioremediation. During the bioremediation process, optimal conditions are maintained (via fertilization, aeration, and irrigation) for petroleum degrading microbes. This strategy is generally effective for degradation of highly toxic, lower molecular weight petroleum compounds. However, with time and repeated application of E&P wastes, the heavier less degradable petroleum constituents tend to accumulate in soils. This results in soils that are essentially water repellent, and that support little diversity of plant or animal life. Ultimately, petroleum concentrations reach a maximum permitted limit, and the land farm can no longer be used for waste applications. We tested the idea that inoculation of land farm soil with earthworms could improve conditions for plant growth, and thereby enhance the rate of soil recovery from chronic petroleum contamination.

Experimental units from the plant growth experiment

RESEARCH RESULTS:

In laboratory studies, we found that plant growth was significantly improved in oily soils where earthworms had been added. Plants grown in the presence of earthworms were nearly twice the size of those grown in land farm soil without earthworms. This improvement of plant growth was observed for shoots as well as roots of experimental seedlings. We also tested the survival of earthworms in land farm soil, and found that amendments of organic matter, such as wheat straw, improved earthworm survival dramatically. In a separate experiment, we used soil respiration as an index for overall biotic activity in land farm soils, and found that earthworm and wheat straw applications also resulted in maximum soil respiration from land farm soil. Thus, a combination of earthworm and organic amendments may have the best potential for long-term benefits to plant growth and the biological quality of land farm soils.

PRACTICAL APPLICATIONS:

Our findings suggest that large-scale field inoculations of earthworms could be a viable strategy for improving soil recovery rates at land farm sites. Using an easily cultured earthworm species, such as *Eisenia fetida*, and readily available organic amendments (e.g., spoiled hay or straw) it should be feasible to broadcast large amounts of inoculum over significant areas (10's of hectares), at reasonable cost. Furthermore, this technique may be applicable to smaller scale contamination sites where episodic or chronic spills have historically occurred.

Dr. Arthur J. Stewart with land manager at a petroleum land farm site in northern Colorado

BENEFITS:

This low-cost, low-tech method provides land managers with another tool to approach remediation and recovery of petroleum-contaminated sites. Department of Defense, Department of Energy, Department of Agriculture, and numerous private organizations are responsible for sites in need of such remediation and recovery.

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COOPERATORS:

Department of Energy, Fossil Energy Program Oak Ridge National Laboratory, Environmental Sciences Division Chevron Corporation.

FURTHER INFORMATION:

Callaham, M.A., Jr., A.J. Stewart, C. Alarcón, and S.J. McMillen. 2002. Effects of earthworm (*Eisenia fetida*) and wheat straw (*Triticum aestivum*) additions on selected ecological properties of petroleum contaminated soils. In press, Environmental Toxicology and Chemistry Vol. 21, July issue.

This work was completed while Callaham was supported by a Post-doctoral research appointment, under the direction of Dr. Arthur J. Stewart, at the Environmental Sciences Division of Oak Ridge National Laboratory.

CONTACT PERSON: Mac A. Callaham (mcallaham@fs.fed.us)

Experimental unit from soil respiration experiment (worms plus straw)

Ecosystem Productivity and Function

Forest Restoration

HISTORY/BACKGROUND

Throughout the boreal and temperate zones, forest restoration efforts attempt to counteract loss of forest cover and degradation of remaining forests. Forests in populated areas of the world constitute the reserve land use, what is left over after clearing for agriculture and urban uses. Forest cover has declined globally, from an estimated 6 billion ha of original forest extent to the present 3.87 billion ha. Yet forest cover is increasing in North America and Western Europe, as a result of shifts from marginal agriculture. Market forces, changing trade policies, agricultural reforms, and conservation efforts are driving conversion of cleared land back to trees in many countries. Many existing forests experience disturbances and stresses that negatively affect ecological stability or maintain the forest in a condition that can be seen as unsustainable. Global assessments of forest condition identify the factors causing these negative trends, including changing land use, increasing demand for fiber, and exogenous stresses such as global climate change, air pollution, and loss of biodiversity through fragmentation.

An international conference on restoration of boreal and temperate forests was held in Vejle, Denmark under the auspices of the International Union of Forestry Research Organizations (IUFRO) and sponsored by the Southern Research Station, the Danish Forest and Landscape Research Institute, and the Southern Swedish Forest Research Centre. Four continents and 19 countries were represented among the 112 participants. The objective of the conference was to document forest restoration knowledge and practice in boreal and temperate ecosystems. The conference organizers framed the program in light of the 10th anniversary of the Rio Conference (UNCED).

RESEARCH RESULTS:

To clarify what restoration means, it is helpful to consider the dynamic relationship between processes that degrade and processes that restore forests in light of two dimensions, changes in land cover, land use, or both (figure below). If we consider the undisturbed, idealized natural mature forest as a starting point, then conversion to other land uses such as agriculture (cultural landscape) or pasture (semi-natural landscape) is through deforestation. Relatively frequent but moderate disturbance (plowing, herbicides, grazing) maintains the non-forest cover.

Similarly, a change in both land cover and land use occurs when forests are converted to urban areas, flooded by dams, or removed along with topsoil/overburden in mining and extractive activities. Such drastic conversion usually involves severe disturbance and the non-forest cover is maintained more or less permanently by structures.

Even-aged harvesting of mature forest in a sustainable manner is a change of land cover but not land use. A new, young forest will result from natural regeneration or by reforestation (i.e., planting trees in a cutover). Unsustainable harvesting without securing adequate regeneration, such as high-grading, may degrade stand structure or diversity. Pollutant loading, outbreaks of insects or diseases (especially exotic species), fire suppression and disruption of natural fire regimes, invasion by aggressive exotic plants, or disasters such as hurricanes and other severe wind events or wildfires can degrade forest stands and change attributes of land cover, but do not change land use. In all these instances, human intervention to restore species diversity or stand structure can be termed rehabilitation.

Reclamation of urbanized land usually requires extensive modification. This may include stabilization of spoil banks or removal of water control structures, followed by tree planting. Because severe site degradation may limit the possibilities for reclamation, this is sometimes called replacement.

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Plantation forestry remains the most effective approach to restoration of forest cover to large areas through afforestation, and recent trends point toward more complex plantations. Rehabilitation of degraded forests increasingly relies on re-establishing natural disturbance regimes and emphasizes "close-to-nature" approaches to regeneration and stand management. Nevertheless, confusion reigns as the term restoration is used indiscriminately, with no consensus even among practitioners in its meaning. Equally confusing is the use of terms such as natural, degraded, and semi-natural to describe forest cover conditions.

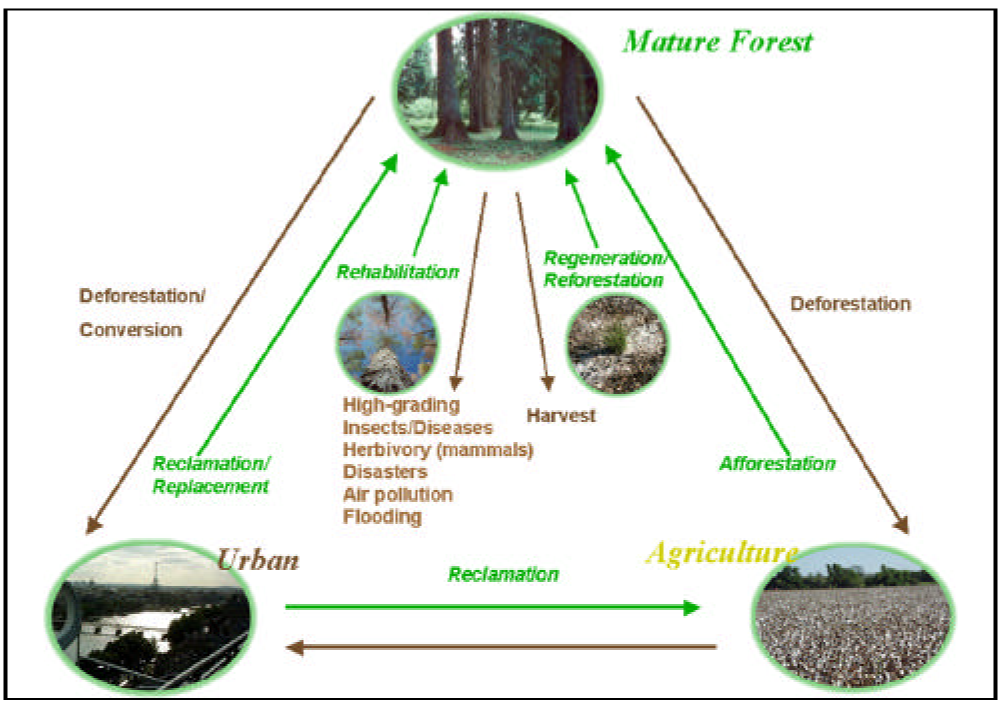
PRACTICAL APPLICATIONS:

Generally, restoration connotes some transition from a degraded state to a former "natural" condition. All the restorative activities described (afforestation, reclamation, and rehabilitation) have been called forest restoration, although to the purist none would qualify as true restoration. In the narrowest sense, termed ecological restoration, this requires a return to an ideal natural ecosystem with the same species diversity, composition, and structure as occurred before human intervention and as such is probably impossible to attain. The approach adopted in the conference may be termed functional restoration. In this approach, the focus is on restoring naturally functioning forests. The term forest restoration is used broadly to describe situations where forest land use and land cover are restored (afforestation or reclamation), as well as instances when an existing forest is rehabilitated (no change in land cover) such that structure or species composition are modified.

FURTHER INFORMATION:

Conference proceedings of short papers were available at the meeting, and can be purchased from DSR Boghandel, Thorvaldsenvej 40, DK-1871 Frederiksberg C, DENMARK. Papers by Forest Service authors will be available for downloading as pdf files from www.srs.fs.fed.us. A special issue of the journal Forestry (Oxford University Press), with selected oral and poster papers, will be published in Spring 2003. CRC/Lewis Press will publish a textbook of the invited papers synthesizing available knowledge and presenting national and regional case studies, hopefully within 18-24 months.

CONTACT PERSON: John A. Stanturf (jstanturf@fs.fed.us)



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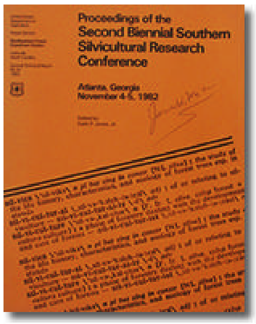
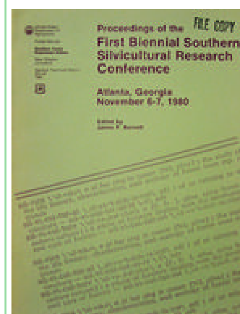
Management Practices

The Biennial Southern Silvicultural Research Conference

This conference was initiated by and continues to be strongly supported by the USDA Forest Service Research Stations of the South. For a number of years the then Southern and Southeastern Forest Experiment Stations held a biennial meeting to coordinate silvicultural research in the South. At this coordination meeting in 1978, William F. Mann, Jr. recommended that a regional conference where all southern silviculturists could exchange ideas would be even more useful. The idea was adopted by scientist and leaders of the Stations, a planning committee was formed, and preparations were begun for the first conference.



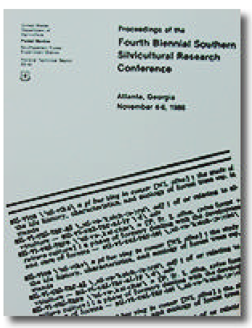
Second Biennial Conference
Edited by Earle P Jones, Jr.
GTR SE-24 SEFES:
Asheville,1983



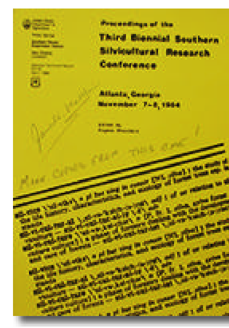
First Biennial Conference
Edited by James P. Barnett
GTR SO-34. SOFES
New Orleans, 1981

As stated by Dr. James P. Barnett in the first conference proceedings "the purpose of this conference was to provide a forum for: exchange among silviculturists, research coordination, continuing education for researchers, review of research in progress, and presentation of new approaches or techniques of general interest".

That first conference, chaired by James P. Barnett of the Southern Forest Experiment Station, Pineville, Louisiana, was held in Atlanta, Georgia on November 6 -7, 1980. It began with keynote addresses, followed by concurrent sessions which included sessions on regeneration, fire, site preparation, thinning, modeling, nutrition, silvicultural systems, uneven-aged management, soils and multi-resources. It was decided that the responsibility for the conference would rotate between the two Research Stations. Thus, the second conference organizing committee was chaired by Earle Jones of the Southeastern Forest Experiment Station, Macon Georgia. It was also held in Atlanta on November 4 - 5, 1982 where 86 presentations were made covering a range of silvicultural topics in 13 different categories. Program chair duties for the third conference rotated back to the then Southern Forest Experiment Station and Eugene Shoulders of Pineville, Louisiana. Following the established pattern, it was held November 7 - 8, 1984 in Atlanta, Georgia.

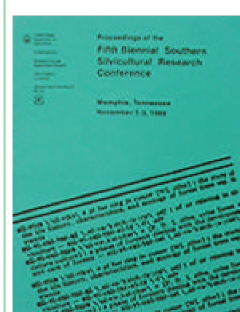


Fourth Biennial Conference
Edited by Douglas R. Phillips.
GTR SE-42. SEFES:
Asheville, 1987



Third Biennial Conference
Edited by Eugene Shoulders.
GTR SO-54. SOFES:
New Orleans, 1985

The fourth conference, chaired by Douglas R. Phillips of the Southeastern Forest Experiment Station, Clemson, South Carolina was expanded to 2.5 days. It like others was held in Atlanta, Georgia on November 4 - 6, 1986. Like the first conference, it opened with a general session of keynote addresses followed by concurrent sessions. This was the first conference to include a poster session and was the first time printed abstracts of presentations were handed out at the conference. James H. Miller from the Southern Forest Experiment Station, Auburn, Alabama was program chair for the fifth conference. For the first time rather than Atlanta, the conference was held November 1 - 3 in Memphis Tennessee. Another first was the inclusion of an optional field trip on the third day of the conference. The sixth conference was also held in Memphis on October 30 to November 1, 1990 and was chaired by Daniel G. Neary, Southeastern Forest Experiment Station, Gainesville, Florida. It included a general session followed by concurrent sessions and an optional field trip on the third day.



Fith Biennial Conference
Edited by James H. Miller.
GTR SO-74. SOFES:
New Orleans,1989

The seventh conference was chaired by John C. Brissette, Southern Research Station, Pineville, Louisiana. It was held November 17 - 19, 1992 in Mobile Alabama. This location was selected to go with a conference emphasis on silviculture of wetland sites. The opening general session on forest wetlands was followed by concurrent sessions and two optional field trips on the third day. Auburn Alabama was the site for the eighth conference chaired by M. Boyd Edwards, Southeastern Forest Experiment Station, Macon, Georgia. It was held November 1 - 3, 1994 and included an opening general session, concurrent session, posters and optional field trips. Beginning with the ninth, the conference was moved to the early spring and held February 25 - 27, 1997 in Clemson South Carolina. Thomas A. Waldrop from Clemson, of the recently combined Southern Research Station, was program chair. The conference included concurrent sessions, posters and field trips.

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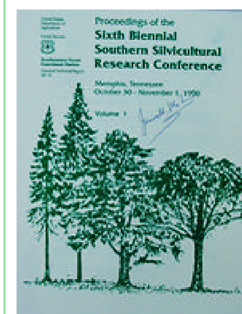
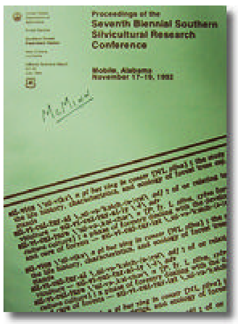
Continuing an alternating east and west location pattern, the tenth conference was held in Shreveport, Louisiana. James D. Haywood of the Southern Research Station, Pineville Louisiana, served as program chair for this meeting, which was held February 16 - 18, 1999.

Although the Forest Service Southern Research Stations have always taken the lead for this conference, it has been such a success because of the involvement of all silviculturists in the South. Over the past 2+ decades in addition to the Stations, universities, consulting foresters, forest industry, state foresters, and professional societies have sponsored this event. The success of this meeting has also been the result of the diligent work of the organizing committees, which consisted of members from these same groups. Of equal importance have been the many individuals that served as moderators, who lead each session and kept everyone on time: This meeting truly has been and remains a meeting organized and held by all southern silviculturists.

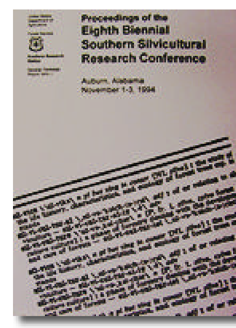


Sixth Biennial Conference
Edited by Sandra S. Coleman & Daniel G. Neary.
GTR SE-70. SEFES: Asheville,1991



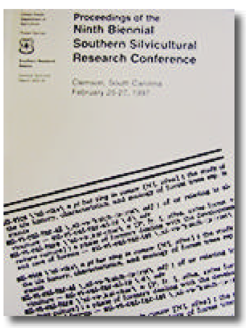
Seventh Biennial Conference
Edited by John C. Brissette
GTR SO-93. SOFES:
New Orleans,1993

From the first conference, presenters at concurrent sessions have been asked to supply a written paper for publication in the proceedings. Papers were then edited and published by the Southern Forest Research Station headquarters. The initial proceedings were 375 pages, which quickly expanded to 500 plus by the second conference and have since been held to around 600 pages. These proceedings have become a useful reference collection highly valued by researches and practitioners in the South. All attendees receive a copy of the proceedings, but for those that have not, like myself, attended most of these conferences, the proceedings are available in most libraries and can be accessed via the Internet at www.srs.fs.fed.us/pubs/index.jsp.



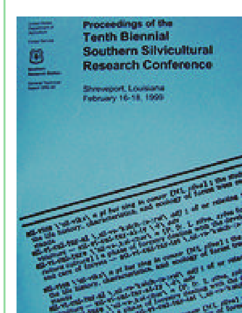
Eighth Biennial Conference
Edited by M. Boyd Edwards
GTR SRS-1. SRS:
Asheville,1995

Our Research Work Unit has a long association with this conference. Two scientists in our unit: Boyd Edwards and Tom Waldrop have served as program chairs for past conferences and have been on other planning committees. Ken Outcalt served as program chair for the most recent conference, the eleventh which was held in Knoxville, Tennessee March 20 - 22, 2001. It included the traditional concurrent sessions, poster session, and field trips. A special session was also held the afternoon of the second day highlighting long-term ecophysiology. The proceedings have now been published and mailed to all participants. It contains papers on nutrition, ecophysiology, prescribed fire, thinning, wood quality, competition, artificial regeneration, natural regeneration, biometrics, site preparation, understory, ecosystems, and insects and diseases. If you were not one of the fortunate 425+ attendees, a limited number of copies are available from our unit in Athens. Just send an email to poutcalt@fs.fed.us or phone 706-559-4312. The proceedings are also available on the web at www.srs.fs.fed.us/bssrc/bssrc2002.

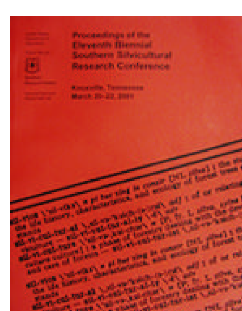


Ninth Biennial Conference
Edited by Thomas A. Waldrop
GTR SRS-20. SRS:
Asheville, 1998

The Twelfth Biennial Southern Silvicultural Research Conference will be chaired by Kristina Connor, Starkville, MS and will be held February 25 - 27 in Biloxi Mississippi. The conference continues to serve as a forum for the presentation and exchange of research information on southern silviculture. For details on conference attendance, check out the web page at www.srs.fs.fed.us/bssrc. Don't miss your chance to be part of a southern forestry tradition.



Tenth Biennial Conference
Edited by James D. Haywood
GTR SRS-30. SRS:
Asheville,1999



Eleventh Biennial Conference
Edited by Kenneth W. Outcalt
GTR SRS-48. SRS:
Asheville,2002

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Management Practices

Benefits of Site Preparation in the Piedmont of Georgia

HISTORY/BACKGROUND:

In 1982, a study on the benefits of six site preparation treatments to survival and growth of loblolly pine was initiated in the Piedmont of Georgia. The treatments to prepare sites for loblolly pines plantations vary widely in cost, completeness of competing vegetation control, and site disturbance. As a minimum, treatment should be sufficient to assure high survival of planted trees. Beyond that minimum, treatment costs must be justified by stimulation of the growth of the planted trees.

RESEARCH RESULTS:

RWU personnel have recently measured the study site after the twentieth growing season and are in process of evaluating the data collected. Publications are available that present information about the growth and yield of the study at three, five, eight, and ten years of age. Also during the lifetime of the study, nine additional studies have been conducted on the site that deal with subjects such as wildlife benefits, stand dynamics, economics of forest management, soil relationships and early succession/vegetation responses following silvicultural practices.

The plots receiving the highest intensive site-preparation treatments had the most survival after 10 growing seasons. Shearing, rootraking, burning, and disking (treatment 5) were better than the others with 94 percent survival after ten years. All treatments improved survival. Height growth and volume production was best for the most intensive treatments (5 and 6). Trees in treatment 6 (same as treatment 5 with additional fertilization and herbaceous weed control) had 2.2 inches more diameter at ten years than the control trees (no site preparation). After 10 growing seasons, treatment 5 yielded 1,159 cubic feet per acre, while the most intensive treatment (treatment 6) yielded an additional 128 cubic feet per acre.

We will not know the full effects of the imposed treatments until the plantings reach full rotation, but the results of the recent twenty-year measurements will provide significant insight about treatment effects and benefits.

PRACTICAL APPLICATIONS:

Forest management is an expensive, high-risk venture that needs to be based on real world experience. This study represents a wide range of site preparation methods that offer information that is based on the intensity of site preparation treatment, which in turn relates directly to economics of cost and profits from the investment. Therefore, a private landowner who owns a small acreage and can invest only minimal capital in reforestation can evaluate the choices and apply them accordingly. The same is true for an industrial forest manager who has capital and wants to use it to maximize the return on the reforestation investment.

BENEFITS:

These studies are demonstrating the importance of good forest management by supplying landowners and managers with science-based information for decisionmaking. It is important to understand that mechanical treatments yield improved growth and survival, and that additional benefits can be obtained from weed control and fertilization.

COOPERATORS:

Oconee National Forest, The University of Georgia and the Georgia Forestry Commission.

CONTACT PERSON: M. Boyd Edwards (bedwards@fs.fed.us)

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Effects Of Prescribed Burning On Vegetation And Fuel Loading In Three East Texas State Parks

HISTORY/BACKGROUND:

Compared to forests with long-interval, high-severity fire regimes, characterized by stand replacing fires, forests with low- to moderate-severity regimes, characterized by low-intensity surface fires may experience greater adverse effects from high intensity wildfires because they are not adapted to them. Generally, these forests adapted to low-intensity surface fires are more adversely affected by fire suppression and other human influences following European settlement. Active fire seasons occur at more frequent intervals than in long-interval types, due to longer fire seasons, higher average temperatures, and exposure to more potential ignitions during a given fire season. They have missed more fire cycles than longer interval fire regimes, and are generally in greater need of wildfire hazard reduction and restoration of ecological integrity. Wildfires in these areas cause more detrimental ecological effects, and pose great risks to firefighters and property. This study was conducted to evaluate the initial effectiveness of prescribed burning in the ecological restoration of forests within selected state parks in Texas. The historic fire return interval at Mission Tejas and Tyler State Parks was 4 to 6 years. It is presently greater than 20 years due to suppression, fragmentation and urbanization of the surrounding areas. Historic fire return interval in the Village Creek State Park was 1 to 3 years. Now it is greater than 20 years. Heavy fuel loads persist throughout the parks due to decades of sporadic use of fire.

RESEARCH RESULTS:

Typical overstory species within the burn units at Mission Tejas and Tyler State Parks included shortleaf pine (*Pinus echinata* Mill.), loblolly pine (*Pinus taeda* L.), sweetgum (*Liquidambar styraciflua* L.), water oak (*Quercus nigra* L.), white oak (*Q. alba* L.), mockernut hickory (*Carya tomentosa* (Poir.) Nutt.), white ash (*Fraxinus americana* L.), and American holly (*Ilex opaca* Ait.). The burn unit at Village Creek was a longleaf pine (*Pinus palustris*)/little bluestem (*Schizachyrium scoparium* (Michx.) Nash.) stand. Due to fire exclusion it was being overtaken by broadleaf trees, such as water tupelo (*Nyssa aquatica* L.), river birch (*Betula nigra* L.), water oak, and redbay (*Persea borbonia* (L.) Spreng.), in addition to the invasive Chinese tallowtree (*Sapium sebiferum* (L.) Roxb.).

County burn bans prohibited burning until they were temporarily lifted following rain episodes. Because of the necessity to wait until a rain event, fuels were wet and resulting burns were weak and spotty. Results indicated that the current applications of prescribed burning do not significantly influence vegetation or fuels. Sustained drought, prior management practices and imposed local burn bans reduced the window within which prescribed burns could be applied, and limited the effectiveness of the burns. This short-term project determined that future burns must be more intense to meet the fuel loads and vegetation goals outlined in the burn plans.

PRACTICAL APPLICATIONS:

Being too cautious could be just as detrimental to the forest as an escaped prescribed fire. Reintroducing fire into these ecosystems, after years of exclusion, requires several steps. Initially, dormant season burns should be conducted every two years to reduce fuel loads sufficiently to initiate early to late spring burns. This will require at least two more cool season burns of greater intensity than the burns presently studied. Spring burns occurring every three years will establish a vegetation restoration phase. After a diverse herbaceous layer and open understory have been established, a maintenance phase of burning every five to eight years, depending on desired vegetation, can begin.

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BENEFITS:

Current burn bans may constrain restoration of fire into these ecosystems. Fire exclusion will ultimately result in a shift from a nonlethal understory fire regime to a stand-replacement regime, accompanied by changes in composition and diversity. In this instance, the failure to reach the objective of reducing fuels in the parks was a direct result of having to wait to burn until after a rain event, which also wetted fuels and reduced the effectiveness of the burn. The Texas Parks and Wildlife Division will benefit from this information by avoiding burning in years with inadequate prescribed fire windows due to extreme drought or flooding. It is expensive and inefficient to extract employees from their normal duties, and use expensive tools, trucks and ATVs to accomplish so little ecologically.

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Tiles with heat-sensitive paint used to estimate temperature of the burn.

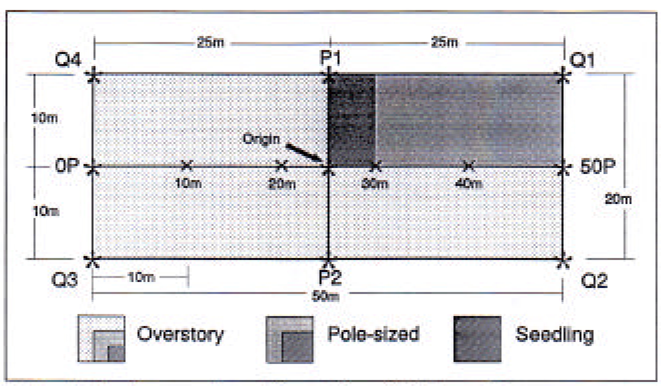

Figure 1. Sampling areas and transects for vegetation and fuel load monitoring.

Management Practices

A National Study on the Consequences of Fire and Fire Surrogate Treatments

HISTORY/BACKGROUND:

The Joint Fire Sciences Program is supporting a national study of the effects of fire and mechanical surrogates on ecosystem functions. Individual studies, located at 13 sites across the United States, are examining ecological and social impacts of using prescribed fire and various mechanical treatments to reduce fuels and wildfire hazard. We are responsible for two sites, the Southeastern Piedmont and the Southern Coastal Plain. With funding under the National Fire Plan, two additional study sites have been located and installed using the same protocol as the National Fire and Fire Surrogates study. The additional sites are in the Southern Appalachian Mountains and the Gulf Coastal Plain.

RESEARCH RESULTS:

RWU personnel are conducting studies on vegetation, stand structure, and fuels. Cooperators are conducting studies of other ecosystem functions including wildlife, soils, nutrient cycling, insects, diseases, and economics. Treatments have been installed and first-year post-treatment data collection is partially complete on the Clemson Experimental Forest (SC) and at Myakka River State Park (FL). Treatments are partially installed and post-treatment data collection began on the Green River Game Management Area in Polk County, NC and the Solon Dixon Research and Teaching Forest of Auburn University near Andalusia, AL.

PRACTICAL APPLICATIONS:

Study results will allow not only a comparison of treatment effects on individual components of the ecosystem, but also a comparison of how multiple components interact. Ultimately, we will know how well mechanical and chemical methods of fuel management compare to prescribed fire, in terms of efficacy of managing fuel loads, costs, and effects on other resources and ecosystem functions.

BENEFITS:

This knowledge, combined with knowledge of economic impacts, will allow forest managers throughout the South to make well-informed decisions of how to protect forests from wildfire.


Prescribed Burn at Clemson Experimental Forest

PROGRESS (2nd Quarter FY02):

Southeastern Piedmont

Treatment installation was completed when prescribed burning was conducted on all units designated as thin and burn. RWU personnel completed all fuels sampling including pre-burn forest floor measurements, moisture content of live and dead fuels at the time of burning, post-burn measurements of forest floor consumption, and post-burn measurements of crown scorch. Field crews began post-treatment measurements of vegetation. RWU personnel began a new study on carbon and nitrogen cycling. Cooperators are continuing post-treatment measurements of small mammal diversity, herpetofaunal diversity, avifaunal diversity, bat abundance, soil properties, insect damage and diversity, incidence of disease, economics, and utilization.

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Southern Coastal Plains

Treatments were completed when the final mechanical operation was applied in April 2002. RWU personnel tracked treatment times and costs of the mechanical operations as they occurred. They have also completed all fuels sampling including pre-burn forest floor measurements, moisture content of live and dead fuels at the time of burning, and post-burn measurements of crown scorch. Field crews have begun collecting post treatment vegetation data and soil samples for determination of nutrient levels and bulk density. Cooperators are collecting post treatment wildlife data for birds and small mammals. The pathology and entomology post treatment data is also being gathered by cooperators.

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Southern Appalachian Mountains

Pretreatment data collection was completed by all cooperators for all disciplines. The mechanical treatment was installed by a contractor who chainsaw felled all trees over 6 feet tall and less than 4 inches dbh. In addition, the contractor felled all stems of mountain laurel and rhododendron, regardless of size. This treatment lowered the vertical fuel component, which should help prevent a wildfire from climbing into tree crowns. Fuels were measured after treatment installation on mechanical only and mechanical + burn treatment areas. Cooperators began post-treatment measurements of avifaunal diversity, pathology, and entomology.

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Gulf Coastal Plains

Pretreatment data collection was completed by all cooperators for all disciplines. The thinning treatments were completed by a contractor on April 8. Personnel from our cooperator, the Solon Dixon Forestry Education Center, began burning treatments on April 5. Even though it was a very dry spring season, they were able to complete the burning of all units on May 22. Thus, all treatments except for the herbicide application are now completed. Field crews from the RWU collected all pre and immediate post fire data and samples. This included fuels, duff depths, duff consumption, crown scorch, and bole char. In addition, they along with Debbie Kennard, the assistant site manager, collected information on burn intensity from all burn treatments. Field crews are now beginning to collect post treatment data on vegetation. Cooperators are collecting post treatment data for birds, pathology and entomology.

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COOPERATORS:
Clemson University, Auburn University, University of Georgia, University of Florida, Florida A&M University, Florida Department of Parks and Wildlife, North Carolina Department of Wildlife, SRS-4101, SRS-4201, SRS-4505, and the Pacific Northwest Research Station.

visit our websites:
www.srs.fs.fed.us/solondixon
www.srs.fs.fed.us/myakka

Smoke Management

Southern High Resolution Modeling Consortium (SHRMC) and a really fast computer

An inter-agency high resolution modeling consortium, one of four regional consortia the U.S. Forest Service is supporting nationwide, is being setup in cooperation with the University of Georgia. SHRMC will perform research and technology transfer necessary to generate products needed by forest managers, environmental scientists and regulatory agencies. Central to the consortium will be the weather prediction model MM5 which will generate high resolution weather data in forecasts out to forty-eight hours for the thirteen southern states comprising USFS Region 8. As a regional consortium, SHRMC will connect agency and university scientists with clients who need real-time predictions of environmental conditions and solutions to related problems. The other consortia locations are University of Washington, University of California, and Michigan State University.

At the consortium's heart are two super computers, each consisting of 32 processors, high speed interconnect fabric, 16 gigabytes of memory, 350 gigabytes of disk storage space, and the Linux operating system, designed and constructed by the Smoke Management Team (SMT) specifically for execution of software that predicts environmental conditions. Software will include the Mesoscale Model Five (MM5) by Pennsylvania State University, Regional Atmospheric Modeling System (RAMS) by Colorado State University, Models-3/Community Multiscale Air Quality (CMAQ) by U.S. Environmental Protection Agency, and the Planned Burn Series (PB Piedmont, PB Coastal Plains) by RWU staff. These are highly complex computational intensive models requiring a tremendous amount of computer run time. With a limited budget and the task of building two computers, one dedicated to real-time model runs, the other to scientific experiments and model development, the design phase began in early 2001 with parts arriving by late 2001. By May 2002 one computer had been setup in the Geography Department of the University of Georgia, the other assembled and awaiting facility upgrades at the U.S. Forestry Sciences Laboratory, Athens, Georgia.

G. Achtemeier admiring the supercomputer

The design of the computers allows for them to be connected together to form an even faster super computer. The High Performance Linpack benchmark software by Jack Dongarra which ranks the top 500 fastest super computers in the world (www.top500.org), was used to test the SHRMC super computers performance. Each system posted an impressive 20 gigaflops (21.47 billion floating point calculations per second). If the computers had been connected together and operational in November 1999, the resulting 40 gigaflops system would have ranked as the 381st fastest computer on the planet. For a real world test MM5 was setup with minimum physics options, three domains with the outer to include the whole United States at a resolution of 36km for a 12 hour forecast,middle domain to include the 13 southeastern states at a resolution of 12km for a 12 hour forecast, and the inner domain to include the whole state of Georgia with a resolution of 4km for six hour forecast. Using this configuration we ran MM5 on two workstations belonging to the University of Georgia and the SHRMC super computer. The workstations used were Silicon Graphics Incorporated (SGI) Origin 2000 (a 300 Mhz 64-bit MIPS R12000 processor) and Sun Microsystems Ultra 10 (a 360 Mhz 64-bit SuperSparc processor). The Sun and SGI runs were useless for real-time predictions because the amount of run time exceeded the forecast time. The SHRMC super computer's run time was 98.5% faster than the SGI machine. When MM5's physics options were increased and the forecast lengthened to 48 hours the run time for the super computer increased to over six hours.

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The the in-house construction of the super computers saved the project in excess of an estimated $100,000 in computer costs alone. The knowledge and experience gained will save the project several thousand dollars annually in maintenance contracts. The implementation of these super computers is a milestone in the history of the Southern Research Station allowing scientists to perform research and produce products previously not within our capabilities. For more information please see the following web sites. Http://www.srs.fs.fed.us/smoke Http://www.uga.edu/atsc/shrmc
Future SHRMC home- Http://shrmc.ggy.uga.edu

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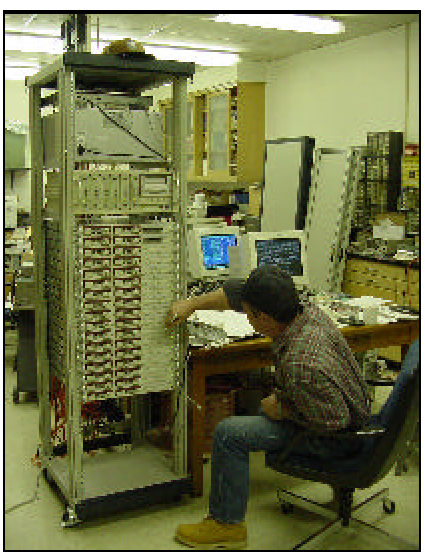
The first of two supercomputers (Firefox) was moved in from the Forestry Sciences Electronics Laboratory to its permanent site at the University of Georgia Department of Geography.



Tim Giddens at Forestry Sciences Electronics Laboratory, building Firefox supercomputer.

Wood Quality

The Impact of Intensive Management on Wood Quality of Southern Pines

HISTORY/BACKGROUND:

The wood industry faces many challenges in the coming decade. Changing environmental polices and reduced acreage for production of wood fiber will require more fiber production from fewer acres. The pressure to produce more wood fiber is leading to intensively managed plantations, which generally accelerates the early growth of the trees and reduces rotation length to maximize return on investment. The pine wood industry in the South is now using intensive cultural treatments such as vegetation control, fertilization, and planting of genetically improved seedlings to increase fiber production. The impact of these intensive environmental treatments on increased growth is positive and significant, but their effects on lumber strength, stiffness and dimensional stability, pulp yields and paper properties is not known. Intensively managed pines grow rapidly during the early years of the rotation, reach merchantable size at a younger age and may contain a significantly higher proportion of juvenile wood thus raising the concern for the use of the new wood supply in traditional products. Juvenile wood is characterized as having a lower specific gravity, shorter tracheids with thinner walls, larger microfibril angles and lower alpha cellulose compared to mature wood. The stiffness and strength of structural lumber containing juvenile wood is significantly lower than that of mature wood and may not meet design specifications. Pulp chips containing large volumes of juvenile wood have significantly lower packed bulk density resulting in fewer chips per digester cook and yield less pulp per ton of green chips. Paper from juvenile wood pulp has good tensile, bust, fold and sheet smoothness but significantly lower tear strength and opacity.

RESEARCH RESULTS:

The Southern Research Station, Disturbance and the Management of Southern Pine Ecosystems Research Work Unit, in cooperation with the Warnell School of Forest Resources at the University of Georgia and forest industry, established the Wood Quality Consortium in 1999. The Consortium currently has eight industrial members. The objective of the Consortium is to conduct and coordinate research on wood properties of fast growing loblolly and slash pine plantations in the South to enable better utilization of wood of future forests for current and emerging forest products.

The Consortium is currently conducting two large studies: a Baseline Study and an Intensive Management Study. The objective of the Baseline Study is to develop a comprehensive baseline of data for conventionally managed planted pine across a matrix of conditions throughout the South to determine the effects of environmental factors and stand variables on wood properties such as specific gravity, tracheid length, microfibril angle and their relationship with stiffness, strength and dimensional stability of wood. Data for the Baseline Study is being collected on operational plantations 20 to 25 years of age on industrial lands from Virginia to Texas. The objective of the Intensive Management Study is to quantify effects of intensive forest management on basic wood properties and interactions with soils and geographic location. The intensive management practices being examined include different levels of fertilization, competition control through herbicide application, fertilization in combination with competition control and planting of genetically selected seedlings. Study material for the Intensive Management Study is being collected from the well-designed, long-term field studied established by Auburn University, North Carolina State University, University of Florida, University of Georgia and Virginia Polytechnic Institute in cooperation with wood industrial cooperatives.

PRACTICAL APPLICATIONS:

These results will give companies the ability to predict basic wood properties for loblolly pine, based on tree, stand, environmental, and intensive management variables, so that wood properties can be factored into growth, yield and management decision models.

FURTHER INFORMATION:

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DMSE
DISTURBANCE AND MANAGEMENT OF SOUTHERN ECOSYSTEMS

A close up of wood samples, each measuring a bit larger than a pencil.

Alexander Clark at X-Ray Densitometer used to measure physical properties of wood on each annual ring.

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